



U.S. Department of Energy Energy Efficiency and Renewable Energy

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INDUSTRIAL TECHNOLOGIES PROGRAM

Large-Scale Evaluation of Nickel Aluminide Rolls in a Heat-Treat Furnace

New rolls could provide cost- and energy-efficient furnace operation

This completed project was a joint effort between Oak Ridge National Laboratory and Bethlehem Steel (now Mittal Steel) to demonstrate the effectiveness of using nickel aluminide intermetallic alloy rolls as part of an updated, energy-efficient, commercial annealing furnace system.

Project teams utilized information from earlier laboratory-fabricated experimental rolls to develop joining procedures and commercial roll fabrication specifications and to assist commercial suppliers with roll fabrication techniques. A full set of 101 rolls, manufactured by two commercial suppliers at cost-competitive prices, were installed in a large commercial austenitizing furnace at Burns Harbor Plate Mill (Mittal Steel). The project team monitored

roll performance in the furnace and evaluated the commercial fabricability, high temperature strength, material stability, wear resistance, and cost-effectiveness of the alloy along with associated energy, environmental, productivity, and cost improvements.

Inspections after 12 months of operation revealed that the roll welds continued to maintain good integrity; the nickel aluminide roll bodies maintained their good high-temperature strength without sagging; and the roll surfaces showed no wear. When tied to other proven equipment, this new technology can provide a more cost- and energy-efficient furnace system. After more than two years of operation, the rolls continue performing well with minimal maintenance.



Nickel aluminide rolls demonstrated at Burns Harbor Plate Mill



Benefits for Our Industries and Our Nation

- Reduces energy consumption, leading to annual industry-wide savings of over 10 trillion British thermal units (Btu)
- Reduces amount of rejected steel that must be reworked
- Increases steel quality, consistency, and mill throughput
- Reduces furnace downtime for transfer roll repair

Applications

- Applies to heat treating, forging, and other high-temperature industries
- ASTM-approved specification (A 1002-099)

Project Participants:

Bethlehem Steel Corporation (now Mittal Steel)

Oak Ridge National Laboratory

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PROJECT PLANS AND PROGRESS:

The project was completed within a one-year time period and organized in four groupings of project activity:

Commercial Nickel Aluminide Rolls

- Welding process development; commercial nickel aluminide cast roll specifications; supplier selection; roll fabrication at several suppliers; field inspection; and roll material physical properties.

Furnace Equipment Upgrades

- Upgraded damper controls; improved safety control equipment; and new AC roll motor drives.

Processing Trials

- Fuel and tons-processed data collection; continual evaluation of roll welds, surface,

and shape; baseline energy data; energy data for furnace light-ups, after-damper installation, extended processing campaigns, and straight-through campaigns; and monitoring of furnace equipment and normal process to insure no interference with trials.

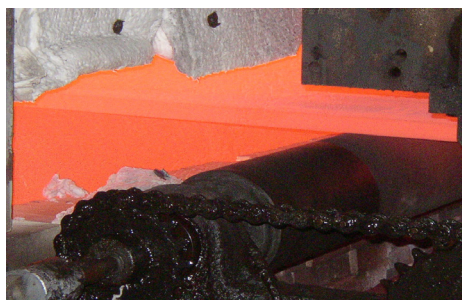
Report

- Energy and furnace data, cost benefits, and picture gathering; data organization and reduction; documentation; coordination and communication with the various groups; and the preparation of the final report including discussion, conclusions, recommendations, and summary, completed the project's technical activity.

Also part of the project was the project cost management, record keeping, and periodic cost and technical progress reporting to DOE.



Close-up view of nickel aluminide roll after nine months



View of hot nickel aluminide roll at furnace exit after twenty months of operation

Steel Program

The Steel Industry of the Future (IOF) subprogram is based in the Industrial Technologies Program (ITP) within the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. The subprogram works with the steel industry to promote development of more energy-efficient and environmentally sound technology for steel processing. Guided by industry-identified research and development priorities, ITP's steel portfolio addresses those priorities that offer the greatest potential for energy savings in cokeless ironmaking, next-generation steelmaking, and yield improvement. To learn more about Steel IOF activities, visit the program web site at: www.eere.energy.gov/industry/steel/

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